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9 Looking for a place to anchor

Confusing thoughts along an interdisciplinary dissertation journey

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Introduction

Writing a doctoral dissertation is always a challenge. There is probably no PhD candidate who has not struggled with formulating a good research question, writing a convincing research proposal, managing time and research design, coming up with a neat literature review, collecting suitable data, developing analysis and writing up results. Here, we will not go into detail about the challenge of making sense of the bits and pieces of data acquired over the years, which eventually leads to handing in a dissertation that brings a bit of something new into science. There is a multitude of books in which authors have made it their business to lend a hand to the confused minds of PhD students. This text here is about another kind of struggle, one that is growing increasingly common, as more and more PhD candidates are working on interdisciplinary or multidisciplinary research projects, particularly in the context of doing science for sustainable development (Kates *et al.* 2001; Farrell *et al.* 2005; Meadowcroft *et al.* 2005).

The ideas presented in this chapter are inspired by the experiences of nine PhD students working in an interdisciplinary European research project called GoverNat, in which we are struggling with the additional hurdles associated with creating an inter-, trans- or multidisciplinary dissertation that stays true to its own objectives while still attracting the benevolence of traditional academic institutions and peer reviewers. Our aim here is to sketch out the situations that we have encountered and to share the lessons that we have learned in the course of facing these challenges, in the hope that other students and their supervisors can benefit from our experience. At the close of this chapter we present a typology of some major challenges arising from interdisciplinary sustainability science work and, reflecting on our experiences, we make some suggestions about how they can be managed and even turned into opportunities.

We begin with a short introduction to the GoverNat research network and some background on our place within it, which we provide by noting our respective points of entry into the research network. Our varied backgrounds (biologist, ecologist, geographer, engineer turned social scientist) brought us to this shared research context from very different directions, and that alone has already

created a lot of creative confusion among us. This diversity of backgrounds, we think, is a challenge special to sustainability science and one that others setting sail into these waters are also likely to encounter. In the main part of this chapter we discuss the challenges and opportunities that we have encountered. In addition to discussing the challenges of interdisciplinarity, we also talk, at times, about challenges associated with conducting intercultural research. We do this for two reasons: first, because it is part of our experience, since the research field for GoverNat covers all of Europe and each of us is conducting case study research in a country that is not our own; and second, because we understand cultural diversity to be a basic characteristic of the complex international regions that are the subjects of environmental governance. At times it has been hard for us to tell whether some troubles we have encountered are caused by the interdisciplinarity of our work or by doing research in another country, so we talk about both challenges as parts of the more general challenge of conducting interdisciplinary environmental science research. We conclude our chapter with some reflections on the strategies that we have each developed to address these challenges in our PhD work, present a typology of major challenges and provide a survival guide list for other PhD students and teachers setting out to work together on similarly complex sustainability science PhD projects.

The GoverNat project and our respective points of entry to interdisciplinarity

GoverNat is a four-year research and training project funded as a Marie Curie Research Training Network under the Sixth Framework Programme of the European Commission's Directorate-General for Research. Generally, GoverNat focuses on multilevel governance of natural resources, with the concrete aim of developing tools and processes for water and biodiversity governance in Europe. The project work is focused mainly on investigating progress and proceedings in the implementation of the European Union Water Framework Directive and Habitats and Birds Directives in various EU member states. In the call for PhD applications it was announced that the early-stage researchers wanting to join the project should ideally have an interdisciplinary background in social sciences. The project aimed to achieve a mix of academic upbringings, attracting and accepting as PhD candidates people with degrees and backgrounds from social and/or natural sciences. A brief overview of our own backgrounds and motivations highlights the mix.

Four backgrounds and four motivations

Minna Santaoja (M.S.) likes to describe herself as an environmental social scientist who in her 'previous life' was an environmental engineer. After a couple of years of work experience in the field, she was not satisfied with the job opportunities offered by the technical education and took up studies in environmental policy to widen her understanding of environmental problems and their

solutions. She finished the interdisciplinary Master's course at the University of Tampere in Finland in 2005 and was then working in research and other projects until joining GoverNat in April 2007. During her environmental policy studies, Minna also became active in environmental NGOs, which shaped her research interests towards public participation and the difficulties of integrating different kinds of knowledge and values in natural resource governance. She is currently employed by the Institute of Social Sciences at the University of Stuttgart in southern Germany. Finding her place in relation to the German sociological tradition, with such an interdisciplinary background as her foundation, has been a troublesome journey for Minna. Indeed, this is what sparked the initial discussion on the topic addressed in this chapter. She thought her interdisciplinary background matched perfectly with the aims of an interdisciplinary project like GoverNat until the reality revealed itself to be slightly more complicated.

Because of his strong interest in environment-related issues, Raphael Treffny (R.T.) decided to specialize in geography while still in high school. Wanting to learn more about the relationship between humans and the natural environment, Raphael conducted his studies with a mixed focus, including both physical and human geography. Eventually equipped with a first degree in geography, he still felt discontented with the explanations and solutions offered for understanding the relationship between social and natural reality, and decided to do an MSc in sustainable resource management. During the coursework, Raphael specialized in biodiversity as well as land and water management with a particular focus on participatory planning techniques. With this interdisciplinary background he felt perfectly prepared for the focus and the interdisciplinary nature of the GoverNat project. However, having been placed for a year in the Geography Department at Lancaster University, he has realized that the interdisciplinary nature of GoverNat poses challenges that he had not anticipated. This is especially the case when writing a dissertation that needs to get assessed by a review committee based within a particular discipline: when the core of the research cuts across various different disciplines, it seems that even the relatively safe harbour of an interdisciplinary field like geography leaves one exposed.

Cordula Mertens (C.M.) studied biology, focusing on zoology and plant ecology. Since the biology courses alone were a bit too one-sided for her interests, she took several language courses and chose history of science as an extra minor. So, next to her upbringing in a more natural-science-focused tradition, she had already had a taste of social sciences before joining GoverNat. After graduating from university, she worked as a volunteer at the Food and Agriculture Organization of the United Nations (FAO) with a project about traditional agricultural systems (GIAHS: Globally Important Agriculture Heritage Systems, an FAO initiative supported by the Global Environment Facility). Now Cordula is a member of the Environmental Social Science Research Group at St Istvan University in Gödöllő, Hungary, where there is a special emphasis on action research (Balázs *et al.* 2005; Reason and Bradbury 2006). Although she was aware from the start that she would be working on a social science PhD addressing the topic of natural resource management, and knew that combining social

and natural science research was going to be demanding, Cordula has been surprised by the way natural science is spoken of in some social science circles. She regards natural and social science as complementary lines of inquiry and is disturbed by the way in which social and natural scientists seem so often to express frustration and disrespect towards each other, where they should try to respect each other's expertise in the respective field and look for a fruitful exchange in which all researchers could learn more and together contribute to solving problems.

Catherine Jolibert (C.J.) has a background in cell biology and physiology and a Master's degree in evolutionary biology and ecology. She has worked as a lecturer in ecology for an undergraduate degree course in the management and protection of nature, as a teacher in natural sciences at high school level, as one of the coordinators and also a contributing author for the 2002 *Rapport sur l'État de l'Environnement en France*, produced by the Institut Français de l'Environnement (IFEN), which covered thirty themes related to the environment, and finally as project manager for the French Ministry of Environment, before joining GoverNat. Catherine is working at the Institute of Environmental Science and Technology at the Universitat Autònoma de Barcelona. In her PhD she is focusing on the interactions between European biodiversity research communities and stakeholders in an effort to help improve science–policy interfaces for biodiversity governance. She is therefore drawing on several disciplines, including social science ones. With an exclusively natural science training, Catherine has occasionally felt lost in the social science domain, but she sees the issue of loss of biodiversity as inherently interdisciplinary and views the challenges of this situation as something she is simply going to need to work with and manage.

Following rather different paths to the GoverNat project, all four of us thought of ourselves as rather a good match with the project aims. Now, in retrospect, that seems to highlight the different understandings we had concerning the task ahead of us. We were excited at doing a PhD as a part of a project with common aims, unaware of the turbulent discussions we would face regarding those aims. What followed for us was an initial disappointment upon realizing that instead of making things smooth, being part of an interdisciplinary sustainability science network seemed to make the PhD process even more demanding. In the following we describe the challenges we faced at the beginning of the GoverNat project, which eventually left us feeling empowered by our transformation from passive participants to owners of the process.

Opportunities and challenges in the GoverNat project

The GoverNat network, which is coordinated by the Helmholtz Centre for Environmental Research – UFZ in Leipzig, consists of ten partner institutes throughout Europe and several affiliated praxis partners. Besides the lead scientists at the partner institutes, there are nine early-stage researchers (PhD students, fellows) and three postdoctoral researchers (postdocs, fellows) in the programme.

The nine early-stage researchers are contributing work to the project at large but are also focused on their individual PhDs, and it is up to each fellow to design their work in such a way that the project tasks also serve their PhD aims. The PhD positions are funded for three years. The overall objective of GoverNat is to develop new solutions for multilevel environmental governance challenges and to facilitate their use by decision-makers in an enlarged European Union. Specifically, the project aims to contribute towards the design of new and improved environmental governance, and, since it is a research and training network, GoverNat aims to achieve this overall objective both by carrying out research and by training the GoverNat fellows in how to design legitimate and effective procedures and practices for environmental governance participation and communication between policy-makers, scientists and the general public.

GoverNat is a complex endeavour. It constitutes a mixture of research and training, operates across no fewer than seven countries, and has no fewer than thirteen different studies under way. It cannot be considered purely as a training network because it has a set of specific research objectives; neither can it be regarded fully as a research project because one of its primary tasks is training the GoverNat fellows. Throughout the course of the project there are a number of schools and training courses, and the fellows can also get training at the institutes where they are based. The topics that the fellows are investigating need to fit into the overall GoverNat research plan and the work needs to serve the project's overarching research objectives. Finally, the environmental governance systems in the various case study countries and in the European Union as a whole are being studied not only individually but also in comparison with each other.

While many challenges that we are facing in our work are just part and parcel of doing a PhD, we think there are several challenges that are directly related to the fact that we are working on sustainability science research topics that concern relationships between social and ecological systems. In the remainder of this section we discuss some of them in detail.

Working away from home: challenges in multicultural interdisciplinary environmental research

Marie Curie funding aims to promote the mobility of young researchers, which meant in practice that the GoverNat fellows had to move country. Doing research in a country other than one's own is becoming more and more common, especially in sustainability science. After all, the issues in sustainability science are often inherently international (for example, pollution does not respect borders) and therefore the research needs to be conducted in a way that takes global and international issues into account. In keeping with this international focus, although living in a foreign country many of the GoverNat fellows were attracted by the idea of including their home country within the comparative case studies for the project. Of course, it also makes sense to include the countries where we are working, but we found cultural differences arising as obstacles to empirical

research, so that we were not always free to choose comparisons on purely scientific grounds. One is also limited by what is possible: what languages one can speak; where one can gain access to the people and information needed to carry out the study, etc. Time concerns also pop up here; three years is a tight schedule for any PhD, but it is especially short in a multicultural, interdisciplinary setting. For example, GoverNat fellows who did not speak the language of their host country well enough to conduct research in that language have had to devote a lot of time to language training. While these examples from our experiences as GoverNat scholars are very specific to our situation, they highlight a more general set of social and physical challenges that come with any interdisciplinary environmental and social science research work that sets out to compare and look at the relationships between different countries and cultures: taking cultural diversity into account is a practical as well as a conceptual matter.

While these kinds of challenges arise in various environmental science settings, say for example when Europeans are studying wildlife management systems in Africa, doing research in a country that is not your own poses particular challenges for the empirical work of social scientists. For example, being a foreigner, how do you explain and justify your research to local people? And how do you interpret their reactions and responses to your questions? In GoverNat this is further complicated by the fact that we are studying participatory processes, and understanding them requires that we get a clear idea of how people in the locality perceive these processes – that we develop close contact with local actors. Are we willing or able to engage in local debates and discourses? Are we ready and able to bring our research results back to the local community for corroboration and critique? To make decisions about which language and in what kind of format this should be done? Or are we content with just extracting material for our PhDs from these local communities and reporting about it to the European Union and the international scientific community? In this kind of work, such verification and discussion of research results seem to us to be necessary: first of all, because promise of due regard is required in order to build the trust that is needed to gain access to information about participation processes, but also because it is a matter of ethical treatment of our research subjects. While ethical treatment of research subjects is always an issue, in our case it is particularly important, because GoverNat plans to conduct policy experiments in the later stages of the project, based on the results and insights gained from the researchers' initial studies and their analysis of participation in European multilevel environmental governance. This raises ethical questions regarding how and on what grounds the researchers should proceed to make interventions that might lead to experiments, how the windows of opportunity for doing so may be located, and whether (and if so, when) it is ethical to use them.

As tricky as acquiring the data required for our multicultural and interdisciplinary GoverNat case studies is, interpreting those data and generating results and conclusions from data covering multiple disciplines, often gathered within a foreign setting, pose even more significant challenges. Can one actually trust

one's data, or oneself with the responsibility of interpreting the data? Being an outsider to the country, its culture and the local setting may be an advantage: one may see things from a different perspective as compared with the locals, which does allow for new and innovative ways of interpreting what is going on. But at the same time we feel a need to stay true to the context in which we collect the data and we are obliged to fit our findings into the bigger European environmental governance picture. This means that alongside our basic research data, the country's history, its particular institutional regimes and political culture must also be taken into consideration. How much time does a researcher need to devote to background study in order to be able to interpret cross-country comparative interdisciplinary social-ecological research data correctly, or at least intelligibly and within its context(s)? How long does one have to live in a country in order to gain a basic understanding about what is going on?

Because of the cross-border nature of environmental problems, international cooperation has been an everyday reality to many environmental scientists for a while now. But as our example illustrates, it does not work by simply packing your bags and starting as usual in the new place. A due consideration of the new cultural context is necessary.

Learning interdisciplinary communication: our GoverNat experience

Since the fellows (PhD students and postdocs) in GoverNat do most of the research work in the project, the variety of backgrounds and skills that they bring to GoverNat has had a considerable impact on how the project is developing. Many of the motivations, aims and strategies of the research project were opened up for discussion during the early stages of the work, as we worked to get to know each other and our research subject. Discussions were held in order to gain a common understanding about the nature of the project and of how each of the fellows would be able to contribute to the undertaking in a fruitful way.

Originally, GoverNat was described as an interdisciplinary project that would combine concepts from economics, political and legal sciences, as well as from ecology, hydrology, philosophy and sociology. In the course of the process of developing GoverNat, less emphasis was put on the natural sciences, with a stronger focus on bringing together ideas from economics, political science, law, sociology and philosophy. The dual focus on nature and society was a point of attraction for us when we joined the project. Its conceptualization within the project has led to discussions among the fellows concerning how 'nature' can be understood, and the role of natural science in supporting our studies of the governance of natural resources. For example, among the four GoverNat PhD fellows writing this chapter, we all have some background in the natural sciences and would, of course, like to make use of this in our GoverNat research. To us it seems clear that this is appropriate, since natural environment and natural resources are an important part of what GoverNat is concerned with, but translating this into practical research work has proved difficult. We find that it is a

mission impossible to convert 100 per cent from a natural into a social scientist in three years, and we are not even so sure that that is what we want to do. And whatever changes we make, they have to be working for us inside the three years, so that we also have the time to make a good PhD. In an interdisciplinary and multicultural project that addresses the interlinkages between nature and society there is enough material to sort through without having to add a whole new training on top. We think that there must be some kind of a middle ground where we can use the skills that we have already developed and learn additional skills specific to the interdisciplinary work that we aim to carry out.

As we searched together for this middle ground, the question of how 'nature' is conceptualized turned out to have a huge impact on the focus taken within each of our individual PhD projects and on our decisions about what methods would be necessary and adequate for obtaining the suitable empirical data. Looking back, we can see that in confronting this question we were faced with a fundamental environmental policy problem: trying to determine whether we are evaluating natural resource governance from a process point of view (e.g. assessing the quality of different types and instances of participation) or from an outcome point of view (e.g. assessing the effectiveness of protection measures developed in participative settings). In the end, we could not find clear grounds within the GoverNat project plan for choosing one or the other approach, so we chose on the basis of our interests and abilities, often being unwilling to choose and looking at both the processes and their outcomes. Looking back, it seems that the need to simplify such complexity is something that every student interested in interdisciplinary problems must face in order to make a manageable PhD.

Finding a common framework

The original idea of the GoverNat project was to focus on governance processes, but many of the fellows felt that the governance processes as such had no meaning unless we also looked at the ecological outcomes of these processes. Here, the different ontologies behind the many different disciplinary perspectives that we brought to the project started to reveal themselves. The fellows with a natural science background felt that they could make a considerable contribution on this point and pushed the idea. People with backgrounds in social sciences felt that close study of the ecological outcomes of these processes would possibly fall outside the scope of the project and might require natural science research. However, this situation also revealed the confusion that can arise when people are working from different ontologies, since the fellows with a natural scientific background were clear about the social scientific nature of the project and did not expect to conduct empirical natural scientific research but rather to read reports and make use of the results from research done by other scientists. For our part, being four fellows with varying degrees of natural science training, we view our role in the GoverNat project as one of bridging the gap between natural science and social science, interpreting natural scientific

data and results for social science purposes. However, this is a point that required considerable effort to communicate.

In order to ensure that comparable data were available for the project-wide European-level environmental governance analysis, the GoverNat research applies a common conceptual framework to all the individual research projects through which all the case studies in the various EU member states are to be analysed. Once we overcame the initial confusion about whether or not natural science research would be conducted, each fellow set out to develop their own research approach and plan, with their own unique interdisciplinary take and their own ontology of the relationships between nature, policy, civil society and economy. However, even with this framework as a reference, there was still a lot of confusion about how all the individual projects would fit together within it in order to produce the interdisciplinary and cross-country comparative analysis results.

Eventually, it was agreed that the GoverNat framework, which was substantially revised in the first year of the project, should not be applied strictly but should be employed as a theoretical heuristic, with implications for how the work of each of the fellows is structured. Not everybody felt able to place their own work within the framework, and not everybody felt comfortable with the assumption that our research would judge the quality of participatory governance processes or with the aim of conducting policy experiments. It was agreed that the experiments could be done also theoretically through interviews. In short, we found that our diversity of ontological perspectives on the GoverNat topic was accompanied by a diversity of epistemological perspectives regarding how the topic could be best understood and a diversity of methodological perspectives regarding how the research into the topic should itself be carried out.

'Nature' in social sciences

The purpose of developing a common framework for the GoverNat project was to facilitate interdisciplinary communication and the effective combination of research results coming from a range of disciplinary contexts. Eventually, a system theoretical model was taken as the basis of the new framework, and a focus on distinctions between economic, social, political and cultural systems was adopted. Fellows who had developed their approaches mainly as social science projects were able to place their work relatively easily within the framework, mostly at the interlinks between the different systems. However, the natural system, now included in the background, was not originally included in the revised framework, and the fellows with a natural science background felt that their work had somehow been written off the plans. Even now, the particular approach adopted in the GoverNat framework does not recognize nature as a separate system but assumes that it is a background context for the four systems of society. This choice of how to conceptualize the relationship between human society and nature has posed a considerable problem for us, as fellows with a natural scientific background and orientation, and we have had difficulties

adhering to the framework when doing the case studies. Upon reflection, we think this difficulty is related to the fact that we view 'nature', or the biophysical environment, as a primary object of study and as a change agent (albeit an unconscious one) in environmental governance. Being required always to subsume 'nature' into one of the various societal systems feels to us as though we are losing it in a social scientific void. We have each developed our own strategies for understanding the place and agency of biophysical systems in environmental governance but it still remains unclear to us what exactly it means to take the system of 'nature' into account in an analysis based on the GoverNat framework. We raise this point here because we think our struggle with understanding the place of 'nature' in environmental governance reflects a challenge that must be faced by any researchers concerned with the interdisciplinary study of complex social-ecological systems.

While there seemed to be an agreement within the project regarding the importance of biophysical systems and of understanding natural processes, since this is the vital basis for all human activities, natural scientific knowledge about the resources to be managed was not viewed as necessary for doing the research. In our view this led to a degree of imbalance in the interdisciplinary training that is taking place within the project, with natural-science-trained fellows being expected to learn about social science but social science fellows not being expected to increase their natural scientific knowledge regarding the objects of natural resource governance. While the social science orientation of GoverNat was more or less clear from the beginning, this perceived imbalance in the ontology of the project seems to us to have somewhat undermined the interdisciplinarity potential of the project, with the interdisciplinary crew of GoverNat being somewhat split into two: between social and natural scientists. This split can even be seen in the bias of this chapter: the opportunity to participate in the joint effort of this writing was offered to all nine PhD and all three postdoc fellows, but all of us who have ended up contributing have either some sort of natural scientific background or a specific research interest relating to the bridging of the gap between natural and social science. So, we find that even here, in our attempt to problematize the topic of how social and physical scientific contributions are combined within GoverNat research, we again bump into the consequences of this diversity of ontologies, the diversity of conceptualizations of human–nature relationships, which seems to us to be a key part of the GoverNat and indeed of the sustainability science adventure.

Being a self-selected, natural-science-biased sub-set of the GoverNat fellows community, we can freely proceed to argue that research intended to provide solutions to fix something that is perceived by humans as being environmentally problematic has to have interdisciplinary collaboration between social and natural scientists at its core. This is because the causal chains behind environmental problems are both physically and socially complex. It is now generally accepted that the reductionism and monodisciplinary approaches that have contributed to the creation of these problems are not sufficient to solve them (Rhoten and Parker 2004), so we do not propose to argue that point here. But we find

within GoverNat that we need to repeatedly emphasize the importance of understanding natural processes in analysing the consequences of environmental governance. The fundamental question here seems to be a philosophical one: whether there is a separate 'nature' outside society, or vice versa, a separate society outside nature. Mostly we have adopted ecosocial or hybrid views, where the two cannot be seen as separate, and this leads us unavoidably to interdisciplinary research, where we are now discovering fundamental theoretical as well as methodological problems that are still very far from being resolved.

The role of natural scientific knowledge within biodiversity governance is a primary point of interest for two of us: C.J. is looking at how European biodiversity research projects engage with stakeholders and is exploring what are the consequences of these engagements for biodiversity governance; M.S. is interested in the practices of the biodiversity knowledge networks and the role of amateur naturalists therein. In both contexts, special challenges associated with collecting the required data have arisen, with respect both to the specification of what data are required and regarding how to gain access to those data. For example, M.S. has discovered that the boundaries between amateurs and professionals, or laypeople and experts, on biodiversity are not at all as clear as might at first be expected. From our perspective, it seems that in social scientific research on natural resource management, the natural scientific knowledge being referenced is often assumed to be complete and correct. If it is viewed critically, it is because it is dominant in relation to other types of knowledge, because it is seen to be crowding out non-science knowledge. However, our experience as natural scientists and our discovery of these blurry lines between amateur naturalists and scientific experts call these presumptions into question. We do not assume that the natural scientific knowledge about our topics is either complete or necessarily correct, and we think this has implications for governance. It seems to us that an informed and critical understanding of available knowledge about the objects of environmental governance, about both the social and the natural processes involved, is required if one is to evaluate the quality of a given governance approach, since the governance tool needs to be appropriate for governing the objects that it targets (Farrell 2007: 15).

Although they are intertwined with human activities, in the end natural resource governance solutions are played out in very concrete terms, in the physical world, and they are subject to the laws of nature. To our thinking, the 'local' in multilevel governance includes not only the people involved in local governance but also local nature. Therefore, it would seem necessary to conceptualize nature here as also being an actor in the governance processes. In suggesting this, we are departing from mainstream disciplinary social sciences, but we are not without companions. We find that the route opened up by, say, Latour (2004, 2005) gives us a lot of options that are not available to us through more discipline-specific social science approaches. Our decision to treat 'nature' as an actor is a reflection of the interdisciplinary ontology that we have chosen to adopt in our research, where human–nature relationships are understood as complex, intertwined and reciprocal relationships, and we propose that this

ontology is important for analysing the human–nature interactions that lie at the heart of environmental governance. The following example of national park management illustrates this point.

Nature's role in natural resource management: a bark beetle outbreak in Bavaria

We see no way out of the trap in which we find ourselves; we must find a way to make our home between the natural and the social sciences, if these are the kinds of research questions we aim to address. Our view on the value of insights that can be gained through adopting such an ontology can be illustrated through reference to one of the case studies analysed within GoverNat: the 1995 bark beetle outbreak in the Bavarian Forest National Park. We propose that it is both reasonable and helpful to interpret the series of events in that case as an instance in which local nature stepped into the governance process as a powerful actor, significantly redefining relationships between stakeholders and substantially influencing the final outcome of the political debate.

In 1994–1995 a whole mountain ridge of spruce trees in the Bavarian Forest National Park, previously weakened by a severe storm, was attacked by bark beetles (*Ips typographus*). This national park was founded on the idea of protecting natural processes, with the aim of creating a primeval forest for the children and grandchildren of Bavarian residents, so the park administration decided not to intervene to stop the bark beetle's mass increase, since the bark beetle increase was a natural part of the forest's process of development. Seeing the dead grey-red furs of the mountain forests, local people were shocked by what they interpreted as the complete destruction of the forest. In the years 1996–1998 there were demonstrations against the national park administration by people opposed to the administration's decision not to intervene but to allow natural processes to go ahead, letting the old forest die. Alongside these protests, a discussion about enlarging the national park, initiated by the state government and Friends of the Earth Bavaria, began in 1996 – precisely at the time when the destruction of the old forest was most severe. There was strong opposition from the local community, but eventually, pressure from local interest groups and politicians at state and national levels led to a compromise: the park was enlarged but bark beetle management would continue in the new part of the park, in order to prevent destruction in the newly integrated areas. The state government, therefore, altered its original plans, putting the new part of the national park under only limited nature protection at first. This decision was a direct response to a political situation created by the decision to allow a normal course of deterioration and regeneration to take place in the older forest area within the park. Subsequently, the natural regrowth of the older forest in the park has changed its appearance, once again giving it the look of a 'Bavarian forest' that the local population expects – yet wilder and more natural than the old planted forest, so that the local population now increasingly identifies with the national park. Accompanying this change in appearance, which resulted from the forest going

about its normal way of being a forest, the political controversy over the place of bark beetle management in the park management strategy has abated. In addition, since the middle of the 1990s communication between the national park administration and local stakeholders has significantly improved and today there is a general acceptance of the national park and cooperation between locals and park managers. Several programmes of the national park administration now specifically address local stakeholders, including special guided tours for the local population, and partnerships between the national park administration and the local tourism businesses.

Interpreting this case study as an instance of environmental governance, we propose that nature can in three ways be seen as a crucial actor influencing the decision-making process. First, the entirely natural destruction of the old forest by the mass increase in the bark beetle population triggered protest by local stakeholders, which forced the state government to make concessions and alter its plans regarding the enlargement of the national park. Second, the natural regrowth of the forest, which can now easily be seen after ten years, has soothed the fears of local people and quieted their protests. This can be understood as a factor helping to soften tensions and to make a resolution of the conflict between local people and the national park administration possible. Finally, the stakeholder consultation and community collaboration practices that are now part of the park management practice were developed as a response to stakeholder protests made during the period when there was controversy, which was spurred by the natural deterioration of the forest.

The idea that inanimate objects can be understood as actors is controversial but is also accepted within many areas of social science. For our purposes here we can refer to Latour's discussion of the idea, particularly as outlined in *Politics of Nature* (2004). Latour seeks a new definition for political ecology where the nature would not paralyse the politics, for in his thought we have never left the state of nature behind, and in order to aim for politics defined by progression towards a good common world, we need to understand the sciences as socializing non-humans. To give another example, using this approach Peltola (2006) has analysed a debate over the citing of a heating plant in Finland. Her analysis suggests that an esker, which was one possible location, assumed a crucial mediating role as a non-human political actor within the debate. The symbolic meanings of the esker as a part of the national landscape imagery contributed to the remoulding of the agenda of local energy production and opened up a way for new political choices, much in the same manner as in our bark beetle example. We do not mean to suggest that nature needs to be viewed as an intentional actor, but this does not stop us from viewing the natural dynamics of natural phenomena, like the deterioration of the old forest area in our example, as agents for change. Although there are precedents to the contrary (Latour 2004; Gunderson and Holling 2002), rigid academic distinctions between the natural and the social sciences seem to make it difficult to pay attention to the kinds of complex physical–social relationships that we feel are central to our understanding of environmental governance and natural resource management. We find it

problematic to imagine that we should provide recommendations that are intended to generate a balance between nature and society but are based on dichotomizing them into two separate systems. Overcoming the strict limits of disciplinary distinctions would seem to allow for recognizing that constant change is an inherent characteristic not only within nature and within human relationships but also within relationships between humans and their environments. For us, one way to capture this recognition is to conceptualize nature as an actor within a set of complex human–nature relationship processes. It seems to us that understanding natural resource management challenges requires that we acknowledge and try to make sense of the blurred boundary between nature and human society, rather than avoiding it.

Interdisciplinary, transdisciplinary or out of discipline?

Within the GoverNat project, as in the wider sustainability science community, there seem to be a number of different interpretations of what interdisciplinarity actually means. For our purposes here, we suggest a working distinction between wide (between natural and social sciences) and narrow (within natural or within social sciences) interdisciplinarity. Such a separation allows us to make clearer the original aim of GoverNat, which was to conduct a form of narrow social science interdisciplinarity while drawing information input from natural sciences. Early confusion in the project highlighted an ambition, mainly stimulated by fellows with natural science backgrounds, towards wide interdisciplinarity. After the impossibility of fulfilling this ambition within GoverNat was accepted, the discussion has instead focused on reconciling different interpretations of how social science works with 'input from natural sciences', reflecting a narrow understanding of interdisciplinarity. Within the project there also seem to be differing levels of enthusiasm for embarking on interdisciplinary endeavours, and different views regarding what their aims should be. A guide to developing interdisciplinary research proposals distinguishes between two types of interdisciplinary research (Tait and Lyall 2007), one aiming to further the expertise and competence of academic disciplines themselves, for example through developments in methodology which enable new issues to be addressed or new disciplines or sub-disciplines to be formed, and the other being problem focused and addressing issues of social, technical and/or policy relevance, with less emphasis on discipline-related academic outcomes (see also Aram 2004). GoverNat, as a project, would seem to correspond to the latter, being designed to be policy-relevant research. For many of the fellows, this problem orientation is a source of motivation for our involvement in GoverNat, but we are still at a stage of our research careers where we need to prove ourselves, and for that, discipline-related outcomes are also important to us. On a day-to-day basis, as we prepare our PhD work, we are working within discipline-specific scholarly departments at universities and our research will eventually have to pass through a university review process. This raises a lot of uncertainties for us, because the criteria for evaluating problem-oriented and purely academic works are not always the

same. Are the reviewers who will eventually judge our PhDs equipped to evaluate our interdisciplinary work?

In science, two developments seem to be going on in parallel: research is becoming more and more specialized, but at the same time there are calls for interdisciplinarity and a holistic understanding. The need for highly specific knowledge regarding detailed technical problems is ever more pertinent and must still be drawn from disciplinary research (Farrell *et al.* 2007). This is a source of inherent insecurity that seems to accompany the carrying out of interdisciplinary PhD work. As GoverNat PhDs, we ask ourselves questions like: even though working in an interdisciplinary project, should I still do a disciplinary PhD? How do I go about it, then, if my background is interdisciplinary or in another field? Is it even possible to be interdisciplinary on a single researcher level? It would mean that one would need to be deeply familiar with several disciplines and then combine them. Should I become a specialist, in one of the caverns of Mary Clark's diamond mine (Clark, Chapter 5 of this book), or a generalist – 'Jack of all trades, master of none'? Where do I belong, and is anyone going to appreciate my work? Where can I get a job after doing an interdisciplinary PhD, if academic recruitment is still based on disciplinary merit? One may need to find a compromise between one's own interests and scientific integrity on one hand, and practical issues relating to the requirements of PhD and the personal economic situation on the other.

Avoiding becoming undisciplined

An interdisciplinary background would seem to allow the easy connecting up of ideas and working between different perspectives, but this can also lead to the problem that one is all the time looking at the 'big picture', eventually being perhaps unable to focus, when the time comes, on a single, specific, answerable question. For some of us, we find that this may lead to the research remaining on a very descriptive and basically too general level. Focusing is necessary; it is not possible to write a PhD dissertation on the topic 'human–nature interactions in natural resource management'. Yet sustainability science and science for sustainable development also need people who are looking at the big picture. A specialist would probably come up with different answers to the same research questions that we are posing, but who is to say which is better? They are just different and as such, we think, also complementary. This leads us to wonder whether in order to be able to do successful interdisciplinary work we need to give up the idea of disciplinarity. Since the problems we are looking at do not contain themselves neatly within disciplines, this should be enough of a reason for us to take a wider perspective. But if we give up completely on the disciplines, then our work is not so much interdisciplinary as undisciplined, lacking the formalism that is expected of us as scholars and PhD candidates and that we think is needed to make sense of the topics we are studying.

The central challenge in interdisciplinary work to us seems to be that we need to get out of our comfort zones and work on a turf that is new to us. For a PhD

candidate it feels a bit like shopping in the big supermarket of social scientific theories and having bits and pieces from here and there. You keep seeing attractive things on the shelves but are unable to take them with you since your basket appears to be full already. It is easy to get lost when everything seems to relate to everything, and one seems to have all the disciplines, theories and literature of social science available. How then to choose and proceed in one's work? It seems that even in interdisciplinary work you still need an academic home, and you are expected to demonstrate knowledge of the important thinkers in your field. Of course you can try to construct your own intellectual house, but that is far more difficult and risky. And the difficulty of choosing your home from among those already built is compounded by the fact that as a student, at the beginning of your academic career, you are not yet really equipped to do so. How are you to know what approaches are out there and what would suit your work? It is like being a cook without much experience: one does not know the basics – which flavours go nicely together, which are conflicting and where the possibilities of revealing something new and distinctive are to be found. To begin the process of exploring and developing a style, one needs to know at least a few recipes that can serve as a basis for developing one's own. These can come from established work and the guidance of supervisors, but those are likely to be discipline-based recipes and may not always include all the ingredients that one believes are important. On the other hand, each recipe, or disciplinary approach, is based on its own foundation texts and major thinkers. So here it would seem crucial to go to the original texts and make up one's own mind on them.

However, one cannot hope to learn all the texts of sociology, political science or philosophy in a year, at the start of a PhD, so rules are needed even for making initial choices about which ingredients to include. In making our first crucial decisions about how to begin sorting through all the available recipes and ingredients, we find that in the end we have only our basic research questions and perhaps a hunch based on preliminary empirical work to guide us.

The research question: an anchor in the storm

After a year or so of sailing the high seas of interdisciplinary ambiguity, we think it is time to settle anchor with a practical problem. From our experiences so far, it seems that when working between disciplinary boundaries, the formulation of the research question becomes crucially important. It provides a way to achieve focus and order amid the interdisciplinary swirl of ideas. In narrowing down the research question from a more general interest in a phenomenon like social-ecological systems, we find that it may be also beneficial to ask yourself, as with any PhD, what set you off on this quest. Once we could answer 'why' questions, what seemed like otherwise arbitrary choices in our research plans began to reveal their justifications. In this way the research question serves as a sort of a guide, helping one to determine which of the big thinkers encountered within the swirl are speaking to one's own specific topic and interests – which are the ones that can serve as points of reference as one works towards one's

personal research goals. This, of course, brings up the need to deal with the normativity of one's work. We think that all research is somehow normative, since there is always, at the start, a choice of which question to try to answer; some things have to be fixed and left out of any empirical inquiry. But interdisciplinary sustainability science research is, by definition, fundamentally normative and this is something that we think it is best to face up to from the outset. We are trying to address practical problems, and to suggest solutions. As with any research, narrowing down a complex phenomenon into a defined research question can be painful, but it is necessary if one wants to proceed in the work. However, when the general topic is a sustainability science topic, like governance for sustainable development, that process of narrowing down is related both to the topic and to the normative aims of the research. Narrowing down the question is hopefully easier after a preliminary research phase (Tait and Lyall 2007), which should give one a better idea of the phenomenon to be studied and of its interesting characteristics. But the inevitable normative aspect of this work (Funtowicz and Ravetz 1991) also requires that we find ways to make scientifically valid assessments of politically charged issues. So the challenges of method, which we might hope to put off until after we have decided on our research questions, also arise at this early stage of the work, since the how, the what and the why need to be more or less collectively specified.

Supervision: a lighthouse on the shore

So far, it seems that there are a lot of challenges and obstacles before us in our PhD work, but, fortunately, we have not set out on this endeavour alone. In such unsteady waters, supervision seems to have an even more important and complicated role in an interdisciplinary PhD process than in the usual disciplinary process. We find ourselves asking questions like: is my supervisor equipped to instruct interdisciplinary work, or are they pushing me towards their own discipline? By contrast, if the supervisor is routinely doing interdisciplinary work and is him- or herself motivated mainly by policy-relevant problems, the supervisor might not be sufficiently sensitive to the concerns of a PhD candidate who needs to find an academic home and write a PhD thesis that can be appreciated in the traditional university evaluation process. Supervising an interdisciplinary project is demanding, and in this sense the GoverNat project is an experiment also for the senior researchers supervising the PhD candidates. As fellows, we believe that our supervisors should be open to new methods coming from different disciplines, be aware of the epistemological differences between the disciplines and be prepared to question the assumptions concerning their own disciplines (Lyall *et al.* 2008). If the expertise of the supervisor does not cover the whole field of the interdisciplinary work, the supervisor should help the student to form an external supervision team and encourage them to contact other relevant experts. At the same time, the supervisor should have realistic expectations towards the project and not expect the PhD candidate to read everything that is somehow connected to their topic. Every PhD student, whether disciplinary or interdisciplinary, will

need help in structuring their dissertation, and when heading towards the evaluation stage it seems to us that the supervisor needs to find examiners who are expert on the topics that the student is addressing but who also sympathize with the idea of doing interdisciplinary work. So there is a lot in the interdisciplinary PhD journey that depends on how one's supervisor engages with the challenge.

Empirical data: a sandy shore to land on

Different disciplines (or traditions or schools) have different ideas about how research should be conducted, both generally and with respect to the role of theory in the work. From our experience so far, we think that a linear, theory-based deductive approach is probably not the best choice for the interdisciplinary work that we are conducting within GoverNat, where our focus is on discovering and explaining new phenomena, as opposed to trying to prove the existence of a phenomenon that has already been described by a theory. In interdisciplinary work it seems to us that the role of the theory is more that of a facilitator: helping us to answer our research questions. This implies a more inductive research process, where the theoretical aspect of the work is not fixed at the beginning but is chosen during and after defining the research question and further developed, together with the research ontology, epistemology and methodology. With a basic conceptual model built from these components, the big thinkers, upon whom one wants to lean and from whom one wants to learn, can be chosen. This is a comforting thought: theory is a choice; there is no one right theory for your PhD ready and waiting for you to find it in the swirl of the university library. The choice of theories is not arbitrary when it is serving a purpose (Funtowicz 2001), and so we think it is important to think carefully about what theories one will use.

Here, in addition to deduction and induction, a third research approach, called abduction (Bromley 2004), is emerging, which could also be helpful for the type of work done by the GoverNat fellows. Hiedanpää (2005) describes the approach as follows: begin with a surprising result, proceed to discern the rules and regularities that brought the result about, and conclude with a case for reform of the standard conditions, either to encourage or to discourage the surprising result – depending, of course, upon whether or not it is desirable. Abduction is thus both a critical and a creative process, which may be helpful for striking a good balance between the descriptive, analytical and normative elements of our work.

Your own convictions: a compass in the storm

Doubt lives in any PhD candidate's mind regarding the appropriate depth of inquiry: should I go all the way back to Aristotle, or is it enough to kick off from a contemporary thinker? For the research questions that we have posed within GoverNat, it would take several lifetimes just to read everything that is relevant to our studies! And there is not always just one valid theory on a question, even in natural sciences. Here we can take the example of light: light explained as

photon particles can, for example, explain how energy is transformed in photosynthesis, whereas light taken as a wave explains colours, for example why the leaves are green. But the relationship between light as a particle and light as a wave is still a source of debate within optical physics. A theory provides one possible perspective on an issue, but there are always others. Again, we find that coming back to specific research questions can help us to define which field and which theories are relevant to our studies and which are not. While a clear research question is important for any PhD study, for an interdisciplinary sustainability science PhD, where there are so many choices that need to be made about which fields and theories to use, it is absolutely vital.

If there is one thing we are certain about so far, it is that confusion seems to be an inherent dilemma in interdisciplinary work. In moderate amounts, confusion can be considered a good thing, fostering a creative state of mind, as long as it does not lead to an infinite regress of unhealthy confusion. In healthy doses, confusion pushes one to go back to scratch and ask, 'What the hell am I doing?' Such reflection can eventually lead to higher-quality work, leading to more conscious choices, but it may also lead to an existential crisis: what is an adequate level of reflection? When thinking about research ontologies, one drifts easily to fundamental questions about the nature of the world. What political and spiritual or religious convictions do I hold and to what extent do I have to be reflective about them? How much does my personal history affect the research I am doing and how much should I identify with my PhD topic? It would be rather painful reading if each sustainability science PhD were to start with a home-baked psychoanalysis: 'I was born in a small village...' Probably a minimum requirement for good-quality research in general is that you believe in what you are doing and have a clear idea of what you are trying to accomplish. In the case of interdisciplinary research for sustainable development, having a clearly defined research question may even turn out to be a determining factor in whether or not you are able to proceed with the work: a clear idea of where you are heading seems, in our experience, to be a way out of this sort of endless existential reflections.

A typology of interdisciplinary challenges encountered

Farrell *et al.* (2007b) suggest that in interdisciplinary projects some discipline with core knowledge and skills concerning the core research problem may become the dominant frame for the study because that discipline has a gatekeeper status, controlling access to key information that persons with a particular disciplinary background are able to interpret correctly. In a project where the multilevel governance of natural resources is the core focus, one might expect that the dominant disciplines would be those that can be used to identify the potential irreversible losses of biological diversity (Heywood 1995) and the depletion of natural resources, including water. At this basic level the expertise is coming from the natural sciences: from disciplines such as conservation biology, and strands of hydrology and ecology. But for the assessment of the

human impacts of biodiversity loss and resource depletion, and for interpreting their consequences for the human system, insights from economics might be considered core, and economics might be understood as a dominant discipline. For the study of the management of resources and design of policies for the abatement of biodiversity loss, political sciences could also be considered as a dominant discipline, at a meta-level, and conservation biology essential at the local level. In GoverNat the dominant disciplines are the social science disciplines of economics, political science and sociology, because the research focus is on the interlinkages between economic, political and social processes. However, there are additional roles for social science in this project. For example, Farrell *et al.* (2007) attribute to social science a special role in the design and implementation of interdisciplinary research projects, noting that as soon as we begin to formally consider how science should be related to policy, the social scientist becomes at the same time the observer and the observed, a target of external as well as internal inquiry. Similarly, Aram (2004) talks about exogenous (created by the 'real' problems of the community) and endogenous (concerned with the production of new knowledge) interdisciplinary knowledge, and a similar distinction between internal and external orientations is also discussed sometimes in terms of Mode 2 science knowledge (Gibbons *et al.* 1994). To our thinking, the whole GoverNat project can be described as an experiment in post-normal science (Funtowicz and Ravetz 1991) or a big, complex action research project (e.g. Hall 1985), depending upon which set of frames one chooses to use to describe it. Our aim here in this chapter is not to analyse GoverNat or to try to fit it into one of these descriptions, but to explore our own challenges as PhD students endeavouring to write dissertations that fit squarely within this domain of interdisciplinary sustainability science. In that respect, here in this chapter we are looking as much at ourselves as at our experiences and trying to learn from how we have responded to our situation.

Reflections on what we have encountered

In summing up the challenges we have so far encountered in this interdisciplinary project, we came up with the typology shown in Table 9.1, in which we identify core challenges and opportunities associated with what we find to be some of the key attributes of interdisciplinary research. Following our presentation of the typology, we then discuss our experience of each of these six attributes in a little more detail, before moving on to our conclusions.

The first challenge would seem to be the *definition of interdisciplinarity*. Is a project interdisciplinary when it just throws together people with different backgrounds and different interests, or should the interdisciplinarity be something more worked through? Aram (2004), for example, distinguishes between instrumental, conceptual and epistemological interdisciplinarity, and transdisciplinarity, depending on the depth of integration, but there are a wide variety of overlapping and sometimes contradicting definitions in use at the moment. What is clear is that the 'correct' definition, if indeed there is one, is not clear. And

Table 9.1 A typology of challenges and opportunities in interdisciplinary sustainability science work

Attribute	*Challenges*	*Opportunities*
Definition of interdisciplinarity	Various definitions; no single definition available and, with the GoverNat project, no common understanding of what is meant by the term	Careful clarification of a single definition or agreement to work from multiple definitions can provide a good starting point for collaboration
Different ontologies	Incommensurable ontologies, where differences are so great that the researchers cannot even understand each other, lead to disagreements and confusion about research objectives	Discussion about the inevitability of ontological diversity can provide an opportunity to reflect on one's own assumptions and on their implications for one's research
Normativity	Choices made in the course of sustainability science research come with normative baggage regardless of whether or not the researcher is aware of this	Mature reflection on one's own normative positions and their implications for the work can lead to better-quality research and reporting
Different epistemologies	In the GoverNat project, even though there is a lot of goodwill we have regularly encountered an inability to communicate across the disciplines, which seem to be linked to fundamentally different ideas how to construe the truth about a research topic	Recognizing the relationship between one's epistemology and one's observations opens up a whole new area for discussion regarding the presumptions that we make and the ethical and moral implications of our propositions
Different methodologies	Often there is no off-the-shelf method available for conducting the kind of empirical interdisciplinary research work that we are doing in the GoverNat project	Triangulation, the use of multiple methods, and taking the opportunity to build one's own methods by drawing from various disciplines can increase the robustness of the work
Lack of a disciplinary home	We have often had difficulty justifying our interdisciplinary research approaches to our more discipline-oriented peers	Not fitting into any one academic box brings a freedom to explore and to come up with something genuinely new

since PhD students are not in a position to decide which definition, if any, should eventually take the proverbial throne, we suggest that a careful clarification of the definition or definitions that one chooses to use, including a clear explanation for why one has chosen them, will need to be one of the first jobs in any interdisciplinary sustainability science PhD.

Second, it seems to us that all interdisciplinary researchers are working more or less in a sort of no man's land, between disciplines, where *a variety of different ontologies* are all more or less valid. Clear and valid assumptions regarding

how the world behind the research topic works, regarding the nature of reality, are vitally important for conducting good research, and the ontological ambiguity that seems to accompany interdisciplinary research is a challenge that needs to be explicitly addressed. For example, over time we have discovered that there was a certain social science ontology behind the GoverNat framework, which was not made explicit and was not clear to many of the fellows at the start of the project. We have since learned that debates about ontology have been central to the so-called science wars (Latour 1999) and that our difficulties with the difference between social and natural science ideas of how the world works are not so unique. From this perspective it is no wonder that we, as PhD candidates, feel slightly lost when it comes to the task of defining our own interdisciplinary research ontologies. Few of us have any readily available answers to questions like: is there an observable reality independent of our perception? Or, do we need to cope with radical uncertainty about how we know things? The question of finding a shared ontology is solved perhaps more easily in narrow interdisciplinary projects, but as we have seen in the case of our GoverNat project, in research that bridges the study of the natural and social worlds the most fundamental of all ontological questions remains wide open to debate: to what extent, if at all, and in what respect, are we, humans, part of nature? Furthermore, it seems that the differences in ontology may not in the end be only between natural and social scientists; they may also be between different disciplines, within disciplines, between different schools of thought and between different individuals' perceptions of the world. That is to say, they may come all the way down to matters of individual style. We believe one way forward here could be to acknowledge the inevitable ontological diversity of interdisciplinary research and to try to appreciate the existence of a range of ontologies within the project. In our case, that means that we may need to accept that a single GoverNat ontology may not emerge during the project.

The challenge of coping with all these different ontologies brings us to the third attribute of interdisciplinarity included in our typology: *normativity*. Our appreciation for this attribute of interdisciplinary sustainability science research is related to the reflective pressure that our debates over ontology have brought upon us, making it necessary to ask ourselves 'why' questions in a new and more penetrating way. Any PhD student needs to ask themselves, why do I want to make a PhD? Why am I interested in this topic? Why did I set out on this quest? What do I want to achieve? Why have I made the decisions that I have made concerning my research approach? But for a sustainability science PhD student these questions take on an additional weight, in part because they are responsible for helping to justify one's ontological, epistemological and eventually also one's methodological choices. Even when working within a discipline, one still needs to have a clear ontology upon which to base a research design, but one is rarely required to give a clear argument defending the presumptions and giving justifications to support its appropriateness. However, in research contexts like the GoverNat project, it has been our experience that we are very often expected to justify our ontologies, and we have found that these justifications are

fundamentally related to our choices regarding what question we are trying to answer with the research – that is to say, with our own normative agendas.

There are always values behind choices made in research, be they more or less explicit. However, our experience suggests that in interdisciplinary research generally, and especially when dealing with environmental governance problems, where the research aims to impact on policy, there is a great deal to be gained from being explicit about the normative choices that one makes. Researchers may not always be aware of the value choices they are making, since these might come pre-packed within disciplinary approaches or theories. But when debates about ontology take centre stage, these presumptions and prejudgements can be evaluated, adjusted or accepted, on the grounds that they serve the purpose of the research. This is not the same as being free from normativity. We view it rather as a mature way of handling the inevitability of normativity in sustainability science.

Closely linked to the challenges of different ontologies and normativity are the challenges of *different epistemologies*. By 'epistemology' we understand here the theory regarding how one can go about knowing a subject of observation. Do we assume that there is only one truth or several valid ways of knowing what is true, and how do we justify our methodological choices for revealing whatever kind of truth it is that we presume exists? The decision to use interviews in gathering data for the research may include an epistemological presumption that reliable answers to the research questions can be found by analysing oral testimonies of those involved. However, a good interview method also presumes that data content is partly controlled by the subjects (people being interviewed), so the epistemological presumption is that accuracy of the data depends not only on good data collection procedures but also on the goodwill of those being interviewed. Natural and social scientists often have different expectations regarding how to reveal 'what is really going on', and indeed regarding the extent to which that is possible.

Different methodologies result from the different ontologies and epistemologies. One needs to choose, for example, between inductive and deductive research designs and to decide on the roles that theory and method will play in the work. It seems to us that methodology in interdisciplinary work is not something off the shelf but needs to be carefully selected and also custom designed, according to the circumstances of each individual research setting and the investigative aims of the researcher(s). While this means that a lot of time and effort may need to be invested in the methods planning for an interdisciplinary sustainability science research project, combining various research methodologies offers students the possibility of exploring the issue from several different perspectives.

In our experience, all these challenges contribute towards making PhD candidates – at least, the ones writing this chapter – feel somewhat insecure and lost, with a feeling that they *lack a disciplinary home*. We find ourselves needing to work harder to legitimate our choices and we are regularly faced with the need to strike a balance between proving ourselves to our peers and teachers at the

university and doing the issue-driven research on complex environmental governance phenomena, which is the ultimate aim of our sustainability science PhDs.

Conclusions

After one year working on our GoverNat PhDs and very many lengthy discussions about these challenges, we think we now know, in theory, where our main problems lie. The next challenge for us is to take charge of our research processes and to act out the successful interdisciplinary research process. Here one could easily start to get cold feet, since the agenda we have set for ourselves is quite ambitious. We imagine that many of the questions we have raised will not be solved during the course of our PhDs but will follow us throughout our research careers. Writing out all the troubles we have had in mind and being brave enough to expose our insecurities to you, our peers and our supervisors has proved to be a good strategy for us and has provided a great deal of fruitful exchange.

Looking back over our typology, among the various lessons we have learned, a golden piece of advice that we were offered along the way stands out: make sure you have your research question very clear. Of course, this is important for any PhD student, but from our experience we believe that for an interdisciplinary sustainability science PhD it is a matter of survival. It is not possible to know all the theories relating to any one discipline, but when one is doing an interdisciplinary PhD, the problem is compounded, since one is faced with a feeling that one should read all the available information from all the relevant disciplines before proceeding with the empirical work. One has to somehow be confident that for all its breadth, the research can still provide something valuable to science. E.O. Wilson's dream of a conscilience (Wilson 1998) – with an all-encompassing explanation of the world and a unity of knowledge – has to be quickly discarded as an aim of a PhD, even if it is still kept in mind as an ideal. Here we think that supervision is crucial: every PhD candidate needs to be able to trust the assessment of a more experienced supervisor to go on with their research questions. In the end, the final choice of the specific research question is always with the student writing the dissertation, and this is a choice that we recommend is considered very carefully.

Two main themes seem to emerge in our typology, and they are very much interrelated. One has to do with the *quality of interdisciplinary scientific work* and the other is about *dominance*: who gets to decide what is meant by interdisciplinarity, what ontological and epistemological assumptions are taken as a basis of a research project proposal, etc. What we think can be drawn out of the typology presented in Table 9.1 is that interdisciplinarity should not be used as a catchword but it is necessary to be clear about where everybody is standing in an interdisciplinary research project. We find it important to keep an open mind towards different ontologies and to be tolerant towards new ways of seeing things, keeping in mind that with a complex problem there is no one right way of

conceptualizing it. Interdisciplinary PhD students should remain wary of different epistemologies and always remember to ask themselves how and why any data have been created, in order to see the underlying assumptions. Regarding methodology, it would seem wise not to put all the eggs in one basket but to examine the object of study with different lenses, using various methods. This is one of the upsides of lacking a disciplinary home: no one can tell you exactly how you should carry out your dissertation work. When you make sure you know why you are doing what you are doing, it is easier to justify your choices also to others. In a project as extensive as a PhD dissertation, one too often focuses on the challenges side of interdisciplinary work and thereby carries the weight of the world on one's narrow shoulders. Once in a while, one needs to be reminded that there is a lighter side to it all. Interdisciplinarity gives a lot of freedom to be creative and to be true to one's own motivations – or, to put it in more catchy words: it gives you the chance to follow your gut feelings.

Keys to happiness

Happily, some clarity has now started to appear for us amid the confusion, and we have begun to realize that we are not the only ones who are confused about the challenges we have discussed above. Debates on scientific methodology have been going on for as long as there has been scientific method, and there seems to be no one definition of what constitutes a discipline. Instead, there are a number of ways to approach interdisciplinary work (e.g. Aram 2004). Lyall *et al.* (2008) suggest that perhaps 'disciplines have survived for so long in the academic world in part because they serve the very useful function of constraining what the researcher has to think about'. The thought is disquieting for us and at the same time comforting. If it is the inherent and basic nature of interdisciplinary inquiries that makes things difficult, then at least we know we are in good company!

Three years seems like an awfully short time to tackle all the challenges mentioned here, and it would probably provide some peace of mind if we could forget about this time constraint and concentrate more on the quality and content of the work. However, in view of how PhDs are funded these days, that may not always be possible. Nonetheless, we believe that when doing an interdisciplinary PhD one needs time to read across the disciplines. This means that the preliminary research phase, in which one is to define the research questions, probably takes more time than in a disciplinary PhD. It is a great opportunity to learn and develop oneself towards the directions that seem meaningful for one's research work and career plans, but it is time-consuming if one wishes to do it well. Going through a painful period of self-reflection, as we four have, might save us some trouble in the future, since we will be less naive when we finish our studies, and, we hope, the lessons we have learned will help us to produce good-quality dissertations. Being exposed to many new things is exciting but we think it is wise to remember where one comes from and not to let the resources that one already holds go to waste: to have the aim, for example, to become an interdisciplinary biologist, as opposed to setting out to become, in the course of three

years, something altogether new. One should be able to differentiate between the PhD and a lifetime research agenda; as the saying goes: a good PhD is a finished PhD.

Another word of advice is to look before you leap: taking on an interdisciplinary PhD may not be advisable for everybody. We find that it requires great enthusiasm for the topic being studied, a willingness to understand other perspectives and an ability to compromise on one's own views, where necessary. Interdisciplinary work would seem to attract people who are especially committed to making sense of the world, and, as is the case for us within GoverNat, shared green values may facilitate the initiation of interdisciplinary communication and a heightened goodwill in the face of confusions and misunderstanding. Tait and Lyall (2007) suggest that good qualities for an interdisciplinary researcher include flexibility and curiosity towards other disciplines, with communication and teamwork skills being of high value. To this, we would add the suggestion that a high tolerance for ambiguity can help ensure a good sleep at night for the interdisciplinary PhD student.

For the students and supervisors who might be reading this chapter, we would like to leave you with one parting thought that we bring with us, as we get back to the basic practical work of turning our research plans into PhDs: when it all seems to be too much, keep this in mind – your research question is your best friend. It does not have to be written in stone from the beginning. Part of its beauty and its value to you is that it is allowed to grow and change. Its imperfections are part of what make it lovable. If you're stuck and you don't know where to turn or what to do next, your research question will be there for you when everyone else seems to have left you on your own to navigate across the troubled waters of your interdisciplinary, intercultural dissertation voyage.

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